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Multidomain preparation practices among national- and international-level South African 5000-m runners: A cross-sectional survey

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Abstract

Background: Championship 5000-m preparation involves running, recovery, psychological, strength, coaching, individualisation, nutrition, and technical/tactical/technological practices. These domains are usually described separately, leaving a scientific gap in how they coexist within the same championship cohort.
Aims: To provide a simultaneous eight-domain description in national- and international-level 5000-m runners in a South African championship cohort and examine how domain summaries depend on alternative response-coding boundaries. The profile is intended for contextual review, not to identify optimal practices or intervention priorities.
Methods: Sixty-four of 81 eligible athletes (42 men, 22 women; 25.5 ± 3.1 years) completed the same nine-section questionnaire, electronically or with in-person facilitation, between mid-October 2025 and March 2026. Operational coding converted 124 retained indicators into eight equal-weight, participant-level descriptive domain percentages. Means were accompanied by 20,000-resample bootstrap 95% confidence intervals; Friedman analysis was exploratory and omnibus only.
Result: Fixed-code domain means ranged from 58.4% to 78.5%. Running-specific training (78.5%) and coaching (78.2%) had the largest descriptive means, while technical/tactical/technological preparation (58.4%) and nutrition/fueling (63.1%) had smaller means. Within-athlete rank distributions differed globally (Friedman $\chi^2(7) = 104.18$, $p < .001$; Kendall's $W = .233$). Broader and stricter five-point boundaries also retained global heterogeneity but altered absolute domain values and ordering.
Conclusion: Domain percentages are specification-dependent descriptive summaries, not validated adequacy scores or a fixed hierarchy. Item-level patterns may support contextual athlete-coach review and hypothesis generation, but the cross-sectional data do not establish which practices should be changed or whether changing them improves performance.

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INTRODUCTION

High-level 5000-m performance emerges from the interaction of aerobic power, sustainable race pace, running economy, durability, speed reserve, and tactical execution. These capacities are developed through systematic endurance training, but the running programme is implemented within a wider preparation system that also includes recovery, psychological skills, strength and conditioning, nutrition, coaching, individualisation, and technical or technological support (Burnley & Jones, 2018; Haugen et al., 2022; Casado et al., 2022; Hunter et al., 2025; Sandbakk et al., 2025; Tønnessen et al., 2024).

The practical relevance of this wider view lies in context rather than prescription. Athletes can report similar running structures while differing in recovery behaviours, monitoring, access to support, programme individualisation, or race-analysis practices. Describing those practices together can support structured athlete-coach review and identify questions for future testing, but a cross-sectional profile cannot determine an optimal preparation model or specify which intervention

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should be prioritised (Impellizzeri et al., 2019; Saw et al., 2016; Rebelo et al., 2026; Washif & Pyne, 2026).

Evidence within individual domains shows why each is relevant to investigate. Strength training can support distance-running performance when appropriately integrated (Blagrove et al., 2018; Llanos-Lagos et al., 2024); recovery and sleep influence the context in which training is tolerated (Kellmann et al., 2018; Dupuy et al., 2018; Walsh et al., 2021; Kong et al., 2025); psychological interventions and coach support may affect performance-related skills and wellbeing (Reinebo et al., 2024; Kelemen et al., 2024; Coussens et al., 2025); and endurance nutrition requires adequate, individualised fueling and attention to energy availability (Burke et al., 2019; Naderi et al., 2023; Mountjoy et al., 2023). These sources establish the relevance of the domains, not the validity of the present scoring boundaries. Technical and tactical demands add a further layer in championship 5000-m racing, where athletes respond to pace changes, position, surges, and the finishing phase rather than reproducing a constant time-trial pace (Kenneally et al., 2021; Casado et al., 2024). Monitoring technologies can assist this process when the information collected is linked to a defined coaching question, but technology use itself is not evidence of better preparation (Rebelo et al., 2026; Washif & Pyne, 2026).

Previous endurance literature has largely examined training load, recovery, strength, nutrition, psychology, coaching, tactics, or monitoring as separate topics, creating a scientific gap in the integrated understanding of these preparation domains (Bourdon et al., 2026). It has not provided an integrated, same-cohort description of how eight preparation domains are reported by a clearly defined group of national- and international-level 5000-m championship athletes. This matters methodologically because summarising heterogeneous ordinal and binary responses into domain percentages may also make apparent patterns sensitive to the chosen operational coding (Sönning et al., 2024).

The present study therefore simultaneously described eight preparation domains within one South African championship cohort, representing a novel integrated approach while making the item-level coding rules explicit (Nicolau et al., 2026). The primary aim was to report participant and domain-level preparation patterns under the fixed operational coding. A secondary methodological aim was to test whether the interpretation of the five-point items changed when broader and stricter response boundaries were applied. The study was descriptive and did not test whether any practice caused better performance, health, or training continuity (Ruotsalainen et al., 2025).

METHOD

Research Design

A cross-sectional observational survey was embedded within a broader sequential multi-method research programme on 5000-m preparation and is reported with reference to the STROBE recommendations for cross-sectional studies (von Elm et al., 2007). Earlier literature review, systematic review, modified Delphi, expert review, and athlete pilot phases were used to develop the questionnaire and its content framework. Those stages supported item generation, content coverage, face/response-process review, and feasibility; they did not constitute psychometric validation of the eight domain summaries used in the present analysis (Boateng et al., 2018; Terwee et al., 2018).

Participants and Sampling

The sampling frame comprised all male and female athletes who competed in the senior 5000 m finals at three consecutive South African Senior Championships (2023-2025). All participants were South African athletes. Championship lists were cross-checked before recruitment, and repeat finalists were retained once, producing 81 unique eligible athletes. Sixty-four completed the study (79.0%). Competitive level was taken from the questionnaire item recording the highest official level at which the athlete had competed: 41 were classified as national level and 23 as international level. No club-only or provincial-only athlete remained in the analysed sample. The study therefore represents a finite championship cohort rather than a convenience sample of recreational runners. Eligibility required participants to be at least 18 years of age, to have competed in the senior 5000 m event at the South African Senior Championships during the sampling period, and to provide written informed consent. Athletes were excluded if they did not meet the championship-based eligibility

criteria or did not consent. The analytic sample comprised all 64 completed eligible records; no imputation was required for the retained 124 indicators.

Instrument

The structured athlete questionnaire was developed through sequential evidence- and expert-informed stages. An in-depth literature review and 5000-m-specific systematic review mapped candidate content. Six expert South African middle- and long-distance coaches (four men and two women, each with more than 15 years of coaching experience and direct high-performance/5000-m experience) then completed two iterative semi-structured interview and controlled-feedback rounds. Modified-Delphi methodology was used to structure expert judgement (Nasa et al., 2021; Gattrell et al., 2024). Consensus was operationalised as thematic stability and interpretive convergence rather than a numerical agreement percentage: Round 2 was considered stable when no substantive new content emerged, and feedback produced no material change in the meaning or priority of the developing framework; ambiguous or overlapping concepts were clarified or merged. A third expert contact reviewed the draft questionnaire for relevance, domain alignment, comprehensibility, redundancy, and completeness rather than generating new themes.

The resulting framework contained eight preparation domains plus a background section. Eight club-level middle- or long-distance athletes who were not part of the championship sample piloted the questionnaire twice and commented on clarity, response interpretation, layout, and feasibility. Minor wording, instruction, and response-option refinements were made where uncertainty arose. This developmental pilot was not powered as a reliability study and no global psychometric coefficient is claimed. The final questionnaire used mixed numerical, binary, categorical, five-point, and explanatory response formats appropriate to the information requested (Boateng et al., 2018; Terwee et al., 2018).

The full questionnaire comprised 191 items across nine sections (A–I). Section A collected biographical and background information, which was used to describe the participants rather than to calculate preparation-domain percentages. A subset of 124 closed-ended indicators from Sections B–I was used to calculate the eight descriptive domain percentages; this number does not represent the total questionnaire item count. Other descriptive, conditional and explanatory items were not included in the domain percentages. Representative items reproduced verbatim from the administered questionnaire are: (1) five-point frequency, C1.1: “How often do you set specific performance goals?” (1= Never, 2= Rarely, 3= Sometimes, 4= Often, 5= Always); (2) five-point agreement, G1.1: “My coach designs a training plan specifically for my needs as a runner.” (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree); (3) binary, E1.2: “Is your strength training periodised (phased blocks with varying intensity/volume)?” (Yes = 1; No = 2); and (4) reverse-directed mental exhaustion, C1.10: “How often do you feel mentally exhausted?” (1= Never, 2= Rarely, 3= Sometimes, 4= Often, 5= Always).

Construction and Scoring of the Multidomain Practice Summary

For the descriptive summary, 124 closed-ended indicators with an interpretable direction were assigned to eight domains: running-specific training (8 indicators), psychological preparation (10), recovery and injury prevention (12), strength and conditioning (18), technical, tactical and technological preparation (26), coaching (22), athlete self-knowledge and individualisation (10), and nutrition and fueling (18). Items without a defensible common direction were excluded from the directional summary. Each retained indicator contributed one unit and therefore received equal weight within its domain, despite differences in content, response format, importance, feasibility, applicability, and evidence base. Equal weighting was an operational analytical decision, not a validated weighting system. The operational rules and weighting approach are summarised concisely in Table 1.

For five-point frequency items, responses of 4 (often) or 5 (always) met the fixed operational criterion; five-point agreement items met the criterion at 4 (agree) or 5 (strongly agree). The mental-exhaustion item was reverse-directed and met the fixed criterion when exhaustion was reported as never or rarely. Selected four-category items used the upper two ordered categories according to the original response anchors, and binary items met the criterion when the response was yes. These

boundaries describe a higher-frequency or stronger-endorsement response within the questionnaire and are not clinical, readiness, performance, or adequacy cut-points.

For each athlete, the descriptive domain percentage was 100 x (number of retained indicators meeting the item-specific operational rule/number of retained indicators in that domain). No overall total score, global adequacy classification, or universal weakest-domain classification was used. Sensitivity analysis tested only the boundary applied to five-point items: a broader rule (responses 3-5 vs 1-2) and a stricter rule (response 5 vs 1-4). The reverse mental-exhaustion item was recoded symmetrically (1-3 for the broader rule and 1 only for the stricter rule), while four-category and binary rules were unchanged. Table 1 summarises the operational scoring structure.

Table 1. Operational Scoring Summary by Preparation Domain

Domain	Retainedn	Response format(s)	Fixed operational rule	Sensitivity/weighting
Running-specific training	8	5-point frequency	4-5 vs 1-3	Broad 3-5; strict 5 only; equal weight
Psychological preparation	10	5-point frequency; one reverse-directed item	4-5; mental exhaustion 1-2 favourable	Broad 3-5 / reverse 1-3; strict 5 / reverse 1; equal weight
Recovery and injury prevention	12	4-category and binary	Upper two ordered categories or Yes	Four-category/binary unchanged; equal weight
Strength and conditioning	18	Binary	Yes	Binary unchanged; equal weight
Technical, tactical and technological	26	5-point frequency	4-5 vs 1-3	Broad 3-5; strict 5 only; equal weight
Coaching	22	5-point agreement	4-5 vs 1-3	Broad 3-5; strict 5 only; equal weight
Athlete self-knowledge and individualisation	10	5-point agreement	4-5 vs 1-3	Broad 3-5; strict 5 only; equal weight
Nutrition and fueling	18	5-point frequency	4-5 vs 1-3	Broad 3-5; strict 5 only; equal weight

Note: 124 retained indicators -> item-specific operational coding -> eight equal-weight participant-level domain percentages.

Procedures

Data collection commenced in mid-October 2025 and was completed in March 2026. Athletes were traced through club and provincial structures, publicly available contact routes, direct engagement at training venues, and coach-mediated facilitation when direct contact was not feasible. Eligible athletes received study information and consent documentation before completing the self-administered questionnaire. Depending on access, it was completed electronically or with in-person facilitation at training venues; both modes used identical item wording, response options, item order, and instructions. Completion required approximately 30-40 minutes (Mallonee et al., 2018). Duplicate participation was prevented before invitation by cross-checking championship lists, assigning one study record to each unique athlete, and inviting repeat finalists only once. Responses were de-identified before analysis.

Analysis Plan

Participant characteristics are presented as mean ± standard deviation or frequency and percentage. Each athlete contributed eight descriptive domain percentages on the same 0- 100% range. Equal numerical scaling does not establish measurement equivalence because domains differ in item count, response format, content, and operational boundaries; the percentages were therefore treated as fixed-specification summaries rather than interchangeable psychometric scales. Domain

means are accompanied by participant-level percentile bootstrap 95% confidence intervals. For each of 20,000 resamples, 64 athletes were sampled with replacement while preserving each athlete's eight-domain response vector; the domain mean was recalculated, and the 2.5th and 97.5th percentiles formed the interval limits (Efron & Tibshirani, 1993).

The Friedman test was retained only as an exploratory omnibus within-athlete rank comparison of the eight domain percentages under a fixed coding specification, with Kendall's W describing the global concordance/effect magnitude. It was not used to establish an objective hierarchy among domains. The same omnibus analysis was repeated under the broader and stricter five-point sensitivity specifications. Pairwise post-hoc ranking was not conducted because exact domain ordering was coding-sensitive. Tests were two-sided with alpha = .05, and interpretation prioritised estimates, confidence intervals, effect magnitude, and specification dependence over isolated p-values. All statistical analyses, including the sensitivity analyses, were conducted using IBM SPSS Statistics version 31.

RESULTS AND DISCUSSION

Results

Participant and Training Characteristics

The cohort had a mean age of 25.5 ± 3.1 years and comprised 42 men (65.6%) and 22 women (34.4%). Forty-one athletes were classified as national level and 23 as international level; no club-only or provincial-only participants were included. All belonged to a club or team, 55 (85.9%) reported working with a registered athletics coach, and every athlete reported following a periodised running programme. Habitual exposure was high: 38 athletes (59.4%) ran seven days per week, 41 (64.1%) completed at least nine running sessions per week, and 35 (54.7%) reported 101-140 km per week (Table 2).

Table 2. Participant Characteristics and Habitual Training Exposure (N = 64)

Characteristic	Value
Age, years	25.5 ± 3.1
Sex	Men: 42 (65.6%); women: 22 (34.4%)
Height, cm	174.7 ± 9.1
Body mass, kg	62.1 ± 7.9
Competitive level	National: 41 (64.1%); international: 23 (35.9%)
Competitive experience	5-7 years: 15 (23.4%); 8-10 years: 20 (31.3%); >10 years: 29 (45.3%)
Registered athletics coach	55 (85.9%)
Club or team membership	64 (100%)
Running days per week	5-6 days: 26 (40.6%); 7 days: 38 (59.4%)
Running sessions per week	3-4: 1 (1.6%); 7-8: 22 (34.4%); 9-10: 30 (46.9%); >10: 11 (17.2%)
Weekly running volume	61-80 km: 11 (17.2%); 81-100 km: 18 (28.1%); 101-120 km: 25 (39.1%); 121-140 km: 10 (15.6%)
Periodised running programme	64 (100%)

Note. Values are mean ± SD or n (%).

Descriptive Domain Percentages and Sensitivity Analysis

Under the fixed operational coding, descriptive domain means ranged from 58.4% to 78.5% (Table 3; Figure 1). Running-specific training (78.5%; 95% CI, 74.8-82.2) and coaching (78.2%; 74.6-81.5) had the largest descriptive means, while nutrition and fueling (63.1%; 59.9-66.2) and the combined technical, tactical and technological domain (58.4%; 55.9-60.7) had smaller means. The remaining four domains clustered between 68.2% and 72.0%. These values summarise the proportion of retained indicators meeting the fixed response rule and do not represent adequacy, readiness, or comparative quality.

The exploratory fixed-specification omnibus analysis showed differences in the within-athlete rank distributions of the eight domain summaries (Friedman $\chi^2(7) = 104.18$, $p < .001$;

Kendall's W = .233). Global rank heterogeneity was also present with the broader five-point rule (Friedman $\chi^2(7) = 300.03$, $p < .001$; Kendall's W = .670) and the stricter rule (Friedman $\chi^2(7) = 274.48$, $p < .001$; Kendall's W = .613). No pairwise post-hoc comparisons were conducted, so these omnibus results do not establish statistically significant differences between any specific pair of domains. The alternative boundaries (Table 4) materially changed absolute percentages and exact ordering, supporting interpretation of the fixed values as specification-dependent descriptive summaries rather than a validated hierarchy. No single cut-off score was used to classify athletes or domains as high or low. Instead, the results were interpreted using the actual scores, confidence intervals, response frequencies, and whether the findings remained consistent when different reasonable scoring approaches were applied.

Table 3. Descriptive Domain Percentages under the Fixed Operational Coding

Domain	Indicators, n	Mean ± SD, %	95% CI	Median [IQR], %
Running-specific training	8	78.5 ± 15.5	74.8-82.2	87.5 [75.0-87.5]
Psychological preparation	10	70.2 ± 14.4	66.6-73.6	70.0 [60.0-80.0]
Recovery and injury prevention	12	68.2 ± 11.9	65.4-71.1	66.7 [58.3-75.0]
Strength and conditioning	18	69.8 ± 13.1	66.6-72.9	66.7 [61.1-77.8]
Technical, tactical and technological	26	58.4 ± 9.9	55.9-60.7	57.7 [53.8-65.4]
Coaching	22	78.2 ± 14.1	74.6-81.5	81.8 [72.7-86.4]
Athlete self-knowledge and individualisation	10	72.0 ± 13.6	68.8-75.3	70.0 [60.0-80.0]
Nutrition and fueling	18	63.1 ± 13.1	59.9-66.2	66.7 [55.6-72.2]

Note: Values are descriptive participant-level percentages based on the fixed operational coding. CI = confidence interval; IQR = interquartile range. The percentages are not validated adequacy or readiness scores.

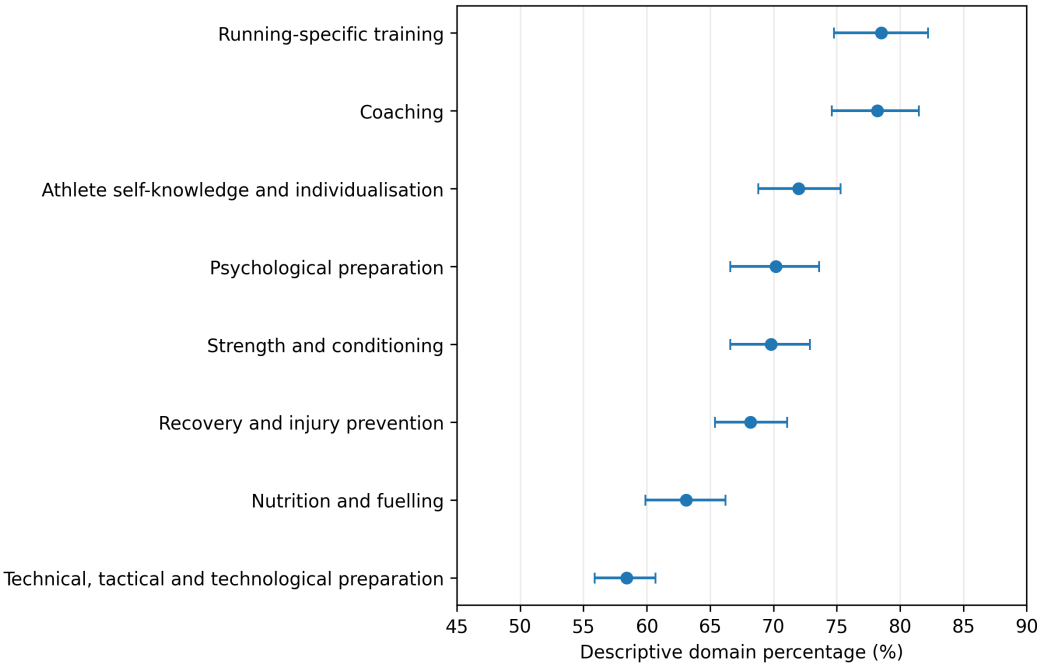

Figure 1. Descriptive domain percentages with participant-level bootstrap 95% confidence intervals under the fixed operational coding. Estimates are descriptive summaries rather than validated adequacy thresholds.

Table 4. Sensitivity of Descriptive Domain Percentages to Alternative Five-Point Response Boundaries

Domain	Fixed coding, mean %	Broader coding, mean %	Stricter coding, mean %
Running-specific training	78.5	97.7	34.2
Psychological preparation	70.2	94.5	26.4
Recovery and injury prevention	68.2	68.2	68.2
Strength and conditioning	69.8	69.8	69.8
Technical, tactical and technological	58.4	87.1	22.5
Coaching	78.2	96.5	38.5
Athlete self-knowledge and individualisation	72.0	96.3	25.9
Nutrition and fueling	63.1	93.4	19.6

Note: Fixed coding applied the prespecified operational boundaries. Broader and stricter specifications modified only the five-point response boundaries as described in the Method. Four-category and binary-item coding remained unchanged. Values are descriptive and should not be interpreted as validated adequacy scores or intervention-priority rankings.

Item-Level Response Patterns

Several core practices were reported at high frequency. Intense sessions were separated by the questionnaire's higher-frequency recovery response in 63 of 64 athletes (98.4%). Interval sessions, long aerobic runs, and recovery runs each met the fixed frequency rule in 61 athletes (95.3%). Effective communication with the coach (frequency item C1.9) and coach support for both sporting and personal development (agreement item G4.5) each met their respective operational rule in 61 athletes (95.3%). These findings describe reported practice frequency and do not establish that the underlying dose, quality, or implementation was optimal.

Lower-frequency responses were also evident for several practices discussed in the main text. Individualised programme design met the agreement criterion in 21 athletes (32.8%), the favourable mental-exhaustion response (never or rarely) in 21 (32.8%), post-race analysis in 22 (34.4%), finishing-kick drills in 23 (35.9%), increased carbohydrate intake during demanding phases in 31 (48.4%), energy-availability/RED-S monitoring in 32 (50.0%), a periodised strength programme in 33 (51.6%), and at least eight hours of sleep in 38 (59.4%) (Table 5). Table 5 is intentionally concise. The high-frequency examples shown met the fixed operational rule in at least 95% of athletes, while the lower-frequency examples shown met the rule in fewer than 60% of athletes and are the specific practices interpreted in the domain-focused discussion.

Table 5. Illustrative Item-Level Response Frequencies under the Fixed Operational Coding

Domain and indicator	Meeting operational rule, n	Meeting operational rule, %
Recovery: intense sessions spaced with adequate recovery	63	98.4
Running: interval, long aerobic, and recovery runs	61 each	95.3 each
Psychology: effective communication with coach (C1.9)	61	95.3
Coaching: supports running and personal development	61	95.3
Coaching: programme designed specifically for athlete needs	21	32.8
Psychology: mental exhaustion never or rarely	21	32.8
Recovery: at least 8 h sleep per night	38	59.4
Strength: periodised strength programme	33	51.6
Technical/tactical: post-race analysis	22	34.4
Technical/tactical: finishing-kick drills	23	35.9
Nutrition: increased carbohydrates during demanding phases	31	48.4
Nutrition: energy-availability/RED-S monitoring	32	50.0

Note: The table presents concise illustrative item-level examples discussed in the main text. High-frequency examples shown met the fixed operational rule in at least 95% of athletes; lower-frequency examples shown met the rule in fewer than 60% of athletes and were selected because they are directly interpreted in the domain-focused discussion. The table is not exhaustive and should not be read as a ranked list of deficits or intervention priorities.

Discussion

The present study provides a simultaneous description of eight preparation domains within a single national-championship cohort. Under the fixed coding, running-specific training and coaching had larger descriptive means than several other domains. However, sensitivity analysis demonstrated that the exact domain values and their ordering were dependent on the selected response boundaries. Accordingly, the findings should be interpreted as patterns of reported preparation practices rather than evidence that certain domains were objectively better developed than others. In this context, external literature is used to explain the relevance of selected practices and to identify areas for further investigation, rather than to validate the scoring rules or suggest that higher endorsement necessarily reflects better preparation quality.

Running-specific training had a fixed-code mean of 78.5%, with interval training, long aerobic runs, and recovery/easy runs among the most frequently reported practices. This pattern is compatible with descriptions of high-level endurance preparation that emphasise high training frequency, substantial low-intensity volume, strategically placed intensive sessions, and increasing competition specificity across the season (Haugen et al., 2022; Casado et al., 2022; Sandbakk et al., 2025; Tønnessen et al., 2024). Nevertheless, the frequent reporting of these practices does not establish whether training volume, intensity distribution, session quality, or athlete-specific training doses were optimal. These considerations are particularly relevant because the effectiveness of running-specific preparation may also depend on how training programmes are designed, communicated, monitored, and adjusted by coaches.

In relation to these considerations, coaching also demonstrated a relatively large fixed-code mean of 78.2%. Athletes commonly reported communication, goal support, progress review, adaptability, athlete involvement, ethical conduct, and broader personal support. However, only 32.8% met the agreement criterion for having a programme designed specifically for their individual needs. Although coach support and relationship quality have been associated with athlete confidence and wellbeing (Coussens et al., 2025), these associations do not validate the coaching percentage obtained in the present study. Instead, the findings indicate that supportive relational practices and perceived programme individualisation were not reported at the same frequency. This distinction is important because individualised preparation may involve not only the organisation of training sessions but also the management of recovery demands and psychological responses throughout the training process.

Consistent with this broader perspective on athlete preparation, recovery and injury-prevention responses revealed a combination of commonly reported planning practices and less frequently reported behaviours. Recovery runs, scheduled recovery periods, coach consultation, and several self-management practices were frequently reported, whereas 59.4% of athletes reported obtaining at least eight hours of sleep. Previous research has highlighted the importance of recovery and sleep in athlete health and performance (Kellmann et al., 2018; Dupuy et al., 2018; Walsh et al., 2021; Kong et al., 2025). Nevertheless, the questionnaire did not assess sleep quality, individual sleep requirements, clinical diagnoses, or readiness. Consequently, reporting fewer than eight hours of sleep cannot be interpreted as a diagnostic indicator or evidence of inadequate recovery. Beyond these physical recovery considerations, psychological preparation represents another relevant component of how athletes manage the demands of training and competition.

In this regard, psychological preparation demonstrated a similarly mixed pattern of reported practices. Goal setting, self-talk, focus, and coach communication were reported more frequently than some other psychological skills, whereas 32.8% of athletes reported experiencing mental exhaustion never or rarely under the reverse-coded criterion. Research on psychological skills supports the importance of examining such practices in athletic populations (Reinebo et al., 2024; Kelemen et al., 2024). However, the mental exhaustion item used in this study was not designed as a diagnostic measure of mental health, burnout, or readiness. Therefore, its contribution is primarily

descriptive and should be interpreted in relation to individual athlete circumstances. Taken together, the recovery and psychological findings illustrate the importance of examining preparation practices within their specific contexts, an approach that is equally relevant when considering the integration of strength and conditioning into endurance training.

Extending the discussion to physical conditioning, strength and conditioning had a fixed-code descriptive mean of 69.8%, with several strength-related practices commonly reported among the athletes. This pattern is consistent with evidence suggesting that appropriately integrated resistance and plyometric training methods can support middle- and long-distance running performance (Blagrove et al., 2018; Llanos-Lagos et al., 2024). However, the present survey did not quantify training dose, exercise technique, load progression, or the quality of integration with key running sessions. Therefore, the domain percentage cannot establish whether the strength programmes implemented by individual athletes were optimal.

An additional consideration concerns the organisation of strength training across the preparation period. In the present study, 33 athletes (51.6%) met the binary criterion for reporting a periodised strength programme. Periodisation is relevant because strength training must be considered in relation to the wider endurance programme. Nevertheless, the absence of a reported periodised strength programme should not automatically be interpreted as a preparation deficiency. Individual needs, seasonal phases, equipment availability, supervision, and programme content may influence the appropriateness of different approaches, and these factors were not captured sufficiently to support a definitive quality judgement. Similar contextual considerations also apply to nutritional preparation, where the appropriateness of specific practices may vary according to training demands and individual physiological requirements.

Within this context, nutrition and fueling had a fixed-code descriptive mean of 63.1%, with general nutritional practices reported more frequently than certain phase-specific or monitoring practices. Specifically, 48.4% of athletes reported increasing carbohydrate intake during demanding training phases, while 50.0% reported energy-availability/RED-S monitoring. Existing endurance nutrition literature supports the importance of investigating carbohydrate availability, recovery nutrition, hydration, and energy availability (Burke et al., 2019; Naderi et al., 2023; Mountjoy et al., 2023). However, the questionnaire was not designed to diagnose low energy availability, nutrient deficiencies, or relative energy deficiency in sport (RED-S). Furthermore, greater endorsement of a particular nutritional practice cannot be assumed to indicate its appropriateness for every athlete.

Consequently, these item-level findings are better understood as potential areas for contextual follow-up rather than indicators of nutritional adequacy or inadequacy. Certain practices may depend on medical considerations, resource availability, individual requirements, or alternative strategies already being implemented. In addition, the operational response boundaries were selected to provide a transparent descriptive framework and were not derived from nutritional guidelines or clinical diagnostic criteria. This need to distinguish reported practices from their actual effectiveness is also important when interpreting technical, tactical, and technological preparation, particularly because these activities encompass different purposes and forms of implementation.

Technical, tactical, and technological preparation had the smallest fixed-code mean (58.4%). However, this combined domain included 26 heterogeneous indicators covering race tactics, running technique, monitoring, feedback, and equipment use. Consequently, it should not be interpreted as a single homogeneous psychometric construct, particularly because its exact position changed under alternative five-point response boundaries. Separate subdomains were not established after data collection because they had not been independently developed and content-validated. Future instrument development should therefore examine whether distinct and coherent technical, tactical, and technological subdomains can be established.

Despite these measurement considerations, the item-level findings provide useful descriptive information about specific preparation practices. Post-race analysis met the fixed frequency criterion in 34.4% of athletes, while finishing-kick drills met the criterion in 35.9%. In contrast, training logs, GPS devices, weather-related adjustments, and several feedback practices were more frequently reported. These differences are relevant because championship 5000-m racing requires athletes to respond to changes in pace, positioning, surges, and finishing demands (Kenneally et al., 2021; Casado et al., 2024). Furthermore, contemporary monitoring frameworks emphasise the collection and interpretation of decision-relevant information rather than

indiscriminate data accumulation (Impellizzeri et al., 2019; Saw et al., 2016; Rebelo et al., 2026; Washif & Pyne, 2026). Although these sources provide a rationale for further investigation of race review and monitoring practices, they neither validate the scoring system used in this study nor support causal conclusions about athletic performance. Overall, these findings reinforce the importance of interpreting preparation domains through their individual reported practices, measurement limitations, and athlete-specific contexts rather than through descriptive percentage rankings alone.

Implications

The findings provide a practical framework for athletes, coaches, and support staff to review preparation practices across eight interconnected domains. Rather than using domain percentages to determine preparation quality, the item-level results can facilitate discussions about training individualisation, recovery, psychological preparation, strength training, nutritional practices, and race-specific strategies. Practices reported less frequently, such as individualised training programmes, post-race analysis, finishing-kick drills, and energy-availability monitoring, may warrant further examination according to athletes' individual needs, competitive demands, and available resources. However, lower reporting frequencies should not automatically be interpreted as deficiencies or grounds for intervention. From a scientific perspective, the sensitivity of domain percentages to different response-coding boundaries highlights the importance of transparent scoring procedures and cautious interpretation of multidomain assessments. Future applications should prioritise instrument validation, contextual interpretation of individual responses, and longitudinal evaluation of relationships between preparation practices and objective performance or health outcomes. Therefore, the present findings offer a descriptive foundation for structured athlete–coach evaluation and future research rather than a validated assessment of preparation adequacy or evidence-based intervention priorities.

Research Contribution

The principal contribution is the simultaneous description of eight preparation domains within one clearly defined South African championship cohort rather than the identification of a best or weakest domain. The study also separates item-level operational response rules from the interpretation of the resulting domain percentages, which is important for a heterogeneous practice inventory rather than a unidimensional scale. The sensitivity analysis adds a methodological contribution: changing the five-point response boundary retained a global within-athlete rank difference but materially altered absolute domain values and exact ordering. This demonstrates that apparently intuitive domain percentages and ranks can be strongly specification-dependent. The result cautions against converting the present multidomain summary into a psychometric readiness scale, universal pass/fail standard, or intervention-priority algorithm before additional validation.

Limitations

Several limitations constrain interpretation. All measures were self-reported and may reflect recall, interpretation, or social-desirability bias. All retained indicators were given equal weight even though they may differ in importance, feasibility, applicability, and evidence base; equal weighting was operational rather than validated. The sensitivity analysis altered boundaries only for five-point items and therefore did not address uncertainty arising from four-category and binary items, unequal indicator counts across domains, heterogeneous domain content, or decisions about which indicators were retained or excluded. The combined 26-indicator technical/tactical/technological domain may conceal distinct constructs. Nonresponse from 17 of 81 eligible athletes could have introduced bias, but questionnaire-level covariates were unavailable for a formal non-response comparison. The finite South African championship cohort limits generalisability beyond comparable adult national- and international-level 5000-m runners, and the cross-sectional design cannot determine whether any reported practice caused changes in health, training continuity, or performance. In addition, the eight domain summaries have not undergone full psychometric validation and should therefore be interpreted as operational descriptive summaries rather than validated multidimensional scales. The use of both electronic and in-person facilitated questionnaire

completion may also have introduced mode-related differences in responses, although identical wording, response options, item order, and instructions were used.

Sugesstions

Future research should proceed in sequence. First, the instrument requires further development and validation, including formal content-validity work where appropriate, adequately powered test-retest reliability/reproducibility analyses, and evaluation of whether coherent subdomains can be developed separately. Second, longitudinal studies should relate selected practices to objective outcomes such as training availability, injury burden, health indicators, and race performance while tracking changes across a season. Third, once reproducible measurement and prospective relationships are established, intervention studies can test whether changing specific preparation practices produces measurable benefits for 5000-m performance.

CONCLUSION

Among national- and international-level 5000-m runners in a South African championship cohort, the fixed operational coding produced different descriptive patterns across eight preparation domains, with larger means for running-specific training and coaching and smaller means for nutrition/fueling and the heterogeneous technical/tactical/technological domain. Broader and stricter five-point boundaries retained global within-athlete rank heterogeneity but changed absolute percentages and exact ordering. The domain summaries are therefore specification-dependent descriptions, not validated adequacy scores, a fixed hierarchy, or a basis for identifying a universal weakest domain. Future work should prioritise measurement validation and prospective studies linking selected practices with objective outcomes before intervention effects are tested.

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AUTHOR CONTRIBUTION STATEMENT

CDS conceptualised the study, developed the instrument, recruited participants, curated the data, conducted the analysis, and drafted the manuscript. CJR and HME provided supervision, methodological guidance, interpretation, and critical revision. All authors reviewed and approved the manuscript for submission.

AI DISCLOSURE STATEMENT

The authors used ChatGPT (OpenAI) to assist with manuscript organisation, language refinement, document formatting and reference checking. The authors critically reviewed and verified the scientific content, data interpretation, and references and retain full responsibility for the manuscript.

CONFLICTS OF INTEREST

The authors declare no financial, institutional, or personal conflicts of interest that could have influenced the conduct, analysis, preparation, or publication of this study.

ETHICAL APPROVAL

Ethical approval for this study was granted by the University of Johannesburg Faculty of Health Sciences Research Ethics Committee (Reference: REC-2454-2023) on 28 November 2023, following Higher Degrees Committee approval (Reference: HDC-01-136-2023) granted on 17 November 2023. The study was conducted in accordance with the ethical principles of the World Medical Association Declaration of Helsinki. All participants were adults and provided written informed consent before participation. Participant data were de-identified and handled in accordance with applicable South African ethical and data-protection requirements. Gatekeeper permission was obtained from Athletics South Africa.

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